Life Cycle Management in the Aluminum Industry
Implementation of LCA for Internal Applications

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Alcan: Overview

- global leader in aluminum, packaging and recycling
- 2002 revenues: US $ 12.5 billion
- 54,000 employees
- active in 42 countries

- Bauxite, Alumina and Specialty Chemicals
- Primary Metal
- Rolled Products Europe
- Rolled Products Americas and Asia
- Engineered Products
- Packaging
- Corporate/Other Offices
Bauxite mining, alumina refining, and aluminum smelting

Semi-finished products (aluminum, plastics, and composites) as well as components for
- light-weight vehicles
- building and construction
- beverage cans and rigid containers

Leading supplier of packaging material
Product Stewardship and LCM

Product Stewardship (PS) is understood as management of the sustainability aspects of products throughout their life cycles.

- Environmental aspects → also relevant for ISO 14001 including LCA as essential element!
- Social issues, including health and safety
- Economic aspects → life cycle costing

Product Stewardship – covers LCM, maybe widely equivalent terminology?
The Life Cycle Perspective

Example of automobile

BAUXITE EXTRACTION → ALUMINA REFINING → PRIMARY SMELTING → INGOT CASTING → FABRICATION (Sheet, extrusions, castings) → PARTS MANUFACTURE → VEHICLE ASSEMBLY → VEHICLE SERVICE → SHREDDING → SORTING → REMELTING
LCA within PS at Alcan

1 Product related issues in the context of environmental management systems
   How to improve the environmental performance of Alcan products (including DfE)

2 Basis for life cycle costing (LCC)
   Efficient use of LCI data for internal cost estimations

3 Marketing/Communication
   Comparison to competing materials/products; benchmarking
EHS (PS) Assessments of Products

Alcan EHS Assessments

- Product related EHS aspects
- Market related EHS inform.
- Input to product rel. issues
- Product related case studies

Relevant input for Alcan sites

Input for Alcan Business Units

Input for Public Affairs and Associations

Input for Public Relations
Simplified LCA Implementation

- Rough data collection via EHS-DB
- Independent LCI data modules via Gabi SW
- Calculation and presentation of 4 indicators
  - Primary energy
  - Global Warming
  - Ecoindicator (w/o energy and global warming)
  - Waste

- Analysis of results and iterative refining, where necessary
Independent LCI Data Modules
Organization & IT-Implementation

- Primary environmental data from one source used for all applications
- Double inventories and inconsistencies are avoided

Client Processes, e.g.
- Internal EHS Reporting
- EHS Benchmarking
- LCAs
- External EHS-Reporting
- EHS Site Management
- Process Controlling

Primary Data Management

- EHS DB Europe

Indicator Calculation

- GaBi4

Needs

Indicators

Excel
Exploitation of Modular LCAs

- Valid for specified product groups
- Usable for
  - Integrated management systems of sites
  - Sustainability and other reporting
  - Public relations
- Living documents/modules
  → easy updates and adaptations
Modular LCA for Alucore®

Panel

H: Total thickness

$d1$: Al-Cover sheet (Front side)

$d2$: Al-Cover sheet (Reverse side)

b: Core size
Example from Transport Sector

Passenger automobile component with Alucore®

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Competing product</th>
<th>Alcan product 2</th>
<th>Alcan product 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>24.2</td>
<td>21.7</td>
<td>21.0</td>
</tr>
<tr>
<td>Municipal Solid Waste Indicator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenhouse potential (CO2 equivalents)</td>
<td>137.2</td>
<td>133.8</td>
<td>222.7</td>
</tr>
<tr>
<td>Primary Energy</td>
<td>193.0</td>
<td>189.0</td>
<td>309.0</td>
</tr>
<tr>
<td>Ecoin-dicator 95 minus</td>
<td>350.4</td>
<td>350.0</td>
<td>349.5</td>
</tr>
</tbody>
</table>

Example from Transport Sector
Passenger automobile component: Alcan product 1

<table>
<thead>
<tr>
<th></th>
<th>MJ</th>
<th>kg</th>
<th>millipoints</th>
<th>kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>EOL Recycling</td>
<td>196.1</td>
<td>15.9</td>
<td>21.6</td>
<td>3.4</td>
</tr>
<tr>
<td>Use</td>
<td>1424.8</td>
<td>101.5</td>
<td>3461.0</td>
<td>8.8</td>
</tr>
<tr>
<td>Transports</td>
<td>8.3</td>
<td>0.6</td>
<td>0.8</td>
<td>0.1</td>
</tr>
<tr>
<td>Finishing</td>
<td>20.0</td>
<td>1.0</td>
<td>1.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Fabrication</td>
<td>240.3</td>
<td>14.8</td>
<td>10.5</td>
<td>8.5</td>
</tr>
</tbody>
</table>
Improvement in Fabrication Phase

Improvement in manufacturing process for automobile component

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Old manufacturing process</th>
<th>New manufacturing process (= Alcan Product 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal Solid Waste Indicator</td>
<td>9.2 kg</td>
<td>8.5 kg</td>
</tr>
<tr>
<td>Ecoin-dicator 95 minus</td>
<td>10.5 kg</td>
<td>15.1 kg</td>
</tr>
<tr>
<td>Greenhouse potential (CO2 equivalents)</td>
<td>18.0 kg</td>
<td>24.0 kg</td>
</tr>
<tr>
<td>Primary Energy</td>
<td>27.8 MJ</td>
<td>10 MJ</td>
</tr>
</tbody>
</table>
Social Aspects & Economic Considerations
Example West Germany: percentage injuries/fatalities of persons which were involved in an accident

- 1980: 17 %
- 1998: 11 %

If this percentage had remained at 17 % this would have caused additional 25’000 injuries/fatalities annually
Crash Management

- Considerations at different speeds:
  - Low Speed: Prevent Damage of Car
  - Medium Speed: Minimize Damage of Car
  - High Speed: Protect Occupants
Side Impacts
### Aluminum in a Car too Expensive?

(cost estimates excluding interests and taxes)

<table>
<thead>
<tr>
<th></th>
<th>Aluminium</th>
<th>Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference masses kg</td>
<td>300</td>
<td>500</td>
</tr>
<tr>
<td>Metal price US$ per 100 kg</td>
<td>130</td>
<td>40</td>
</tr>
<tr>
<td>Scrap value (80 % recycling rate) US$ per 100 kg</td>
<td>50</td>
<td>15</td>
</tr>
<tr>
<td>Net materials cost US$ per 100 kg</td>
<td>80</td>
<td>25</td>
</tr>
<tr>
<td>Total material costs US $</td>
<td>240</td>
<td>125</td>
</tr>
<tr>
<td>Additional gasoline consumption litres</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>additional gasoline costs (w/o taxes) US $</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Total life cycle costs US $</td>
<td>240</td>
<td>725</td>
</tr>
</tbody>
</table>

Gasoline savings over the life cycle are higher than raw material value difference
Economic Aspects - Statements

- Life cycle costing not (yet) sufficiently considered by customers
- Many aluminum parts are already the most economical solution (w/o use and EOL costs)
- Real price difference between aluminum and other materials depends on position on the learning curve
- Aluminum industry should invest more into R&D - for future generations
Alcan’s product stewardship program enables efficient implementation of LCA.

Data and results can be used for product assessments as well as ISO 14001 activities.

LCA can be implemented on a transparent basis, suitable for operational as well as strategic decision-making.

Planned to cover all product groups of Alcan.

Social & economic aspects are more and more included.